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VERIFICATION OF TRANSLATION

Commissioner for Patents
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Sir:

I, Yohei Kinoshita, having been warned that willful false statements and the like are punishable by fine or imprisonment or both, under section 1001 of Title 18 of the United States Code, and may jeopardize the validity of the above-captioned application and any patent issuing thereon, declare:

(1) I am a patent attorney authorized to practice law in Japan and am engaged in the practice of law at Teclaw Patent & Law Office, Nishi-Shimbashi 3-chome, Minato-ku, Tokyo 105-0003.

(2) I am fluent in the Japanese and English Languages.

(3) I certify that the attached translation is an accurate English translation of Japanese patent application 048970/2003 filed February 26, 2003 including the drawings.

(4) All of the statements made herein of my own knowledge are true and all statements made herein on information and belief are believed to be true.

January 23, 2006
Date

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[Title of the Invention] Press felt for papermaking

[What is claimed is]

[Claim 1] A press felt for papermaking, having a wet paper web contact surface and a roll contact surface,

characterized in that it has an anti-rewetting layer, comprising a base body, a batt layer, and a non-oriented film;

and said anti-rewetting layer has an opening of a three-dimensional structure, comprising an opening edge section, a wet paper web side opening, and a roll side opening; and said wet paper web side opening is formed larger than said roll side opening.

[Claim 2] A press felt for papermaking as claimed in claim 1, wherein said opening has an opening tube section and is funnel-shaped.

[Claim 3] A press felt for papermaking as claimed in claim 1 or 2, wherein said anti-rewetting layer is made of nylon, and its elongation at break is 300% or more.

[Claim 4] A press felt for papermaking as claimed in any one of claims 1-3, which further has a flat opening.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention belongs]

The present invention relates to a felt for papermaking, used for a press part of a papermaking machine, a press felt which may improve a water removing capability particularly (hereinafter, it may be referred to merely as a "press felt").

[0002]

[Prior Art]

In a papermaking process, a press apparatus, shown in Figure

13, is used conventionally to remove water from a wet paper web.

This press apparatus, comprising a pair of press rolls P, P, and a pair of press felts 12, 12 supporting a wet paper web, squeezes water from a wet paper web W by applying pressure to the press felts 12, 12 and the wet paper web W, at the press part of the press rolls P, P.

In addition, water squeezed from the wet paper web W is absorbed by the press felts 12, 12.

The press felts 12, 12 comprise a base body for maintaining strength and a batt layer provided on the both sides of the base body; and the base body and the batt layer are intertwiningly integrated by needle punching (not shown).

[0003]

Figure 14 is an enlarged partial view of a press part of Figure 13 to explain a transfer of water squeezed from a wet paper web W.

In addition, detailed structure of press felts 12, 12 is not shown in this figure.

When the pair of press rolls P, P rotates in an arrow direction of the figure, the press felts 12, 12 supported by the press rolls P, P, and the wet paper web W are sent in an arrow direction after going through the press part.

As described above, the press felts 12, 12, and the wet paper web W are pressurized in the press part, and water in the wet paper web W is squeezed and absorbed by the press felts 12, 12.

[0004]

However, since pressure applied to the wet paper web W and the press felts 12, 12 is abruptly released in the part which is from the center of the press part (the nip part) to the exit, the volume of the press felts 12, 12 suddenly expands in this part.

As a result, in addition to that, negative pressure is generated in the press felts 12, 12 and a capillary phenomenon occurs since the wet paper web W comprises a fine fiber, and therefore, there occurs a phenomenon, wherein the water absorbed by the press felts 12, 12 transfers to the wet paper web side again.

This is referred to as a re-wetting and known as a problem associated with a conventional press apparatus.

[0005]

There is a felt for preventing such re-wetting as shown in Figure 15 (refer to Patent Document 1).

This is a felt 11, comprising a base body 31 and batt layers 21, 21, provided on both sides of the base body 31, wherein a hydrophobic film 41, made of a span bond, is provided on a base body 31, and a press roll side layer and a wet paper web side layer are separated by this hydrophobic film 41. It is assumed that when this felt 11 is used, re-wetting may be prevented even when the pressure applied to the felt 11 is suddenly released, since the water absorbed in the press roll side layer does not easily transfer to the wet paper web side.

In addition, there is a film, in which a barrier layer is provided to prevent the water once absorbed in the barrier layer from being transferred to the wet paper web side (refer to Patent Document 2).

[0006]

Furthermore, there is a press felt, in which a foam layer having closed cells is provided (refer to Patent Document 3). It is assumed that when this felt is used, re-wetting may be prevented since water is held in the cells.

[0007]

[Problems to be solved by the Invention]

However, there is a problem in the felts disclosed in Patent Document 1 and Patent Document 2, that satisfactoryeffects may not be obtained since a hydrophobic film, having a great number of apertures, and a porous film are used and therefore, it is difficult to prevent the transfer of water.

In addition, since how to discharge water held in the cells is not disclosed in Patent Document 3, there is some doubt as to effects of the press felt as a whole.

[0008]

[Patent Document 1]

U. S. Patent No. 5372876

[Patent Document 2]

Unexamined Japanese Patent Publication No. 8888/1991

[Patent Document 3]

U. S. Patent No. 4830905

[0009]

[Means to solve the Problems]

The present invention solved said problems by providing a press felt for papermaking, having a wet paper web contact surface and a roll contact surface, characterized in that it has an anti-rewetting layer, comprising a base body, a batt layer, and a non-oriented film; and said anti-rewetting layer has an opening of a three-dimensional structure, comprising an opening edge section, a wet paper web side opening, and a roll side opening; and said wet paper web side opening is formed larger than said roll side opening.

[0010]

[Functions]

In the present invention, an opening of a three dimensional structure of an anti-rewetting layer exhibits an anti-rewetting function

effectively.

[0011]

[Embodiments]

A press felt according to the present invention will be explained, referring to Figure 1 - Figure 9.

Figure 1 is an exploded perspective view of a press felt according to the present invention, and Figure 2 is a cross-sectional view thereof.

This press felt 10 comprises a base body 30, a batt layer 20 made of staple fibers, and an anti-rewetting layer 40 which will be explained later, and all three of which are intertwiningly integrated by needle punching.

The base body 30 is provided to impart strength to the press felt, and a woven fabric or a band-shaped body which is not woven by a thread member, etc. is used as a material thereof.

Natural fiber such as wool, etc. or synthetic fiber such as nylon 6, and nylon 66, etc. excellent in abrasion resistance, fatigue resistance, elongation, and fouling resistance, etc. may be used for the base body 30 and the batt layer 20.

[0012]

In addition, while in the case of the press felt 10 of Figure 1, the batt layer 20 is provided between the anti-rewetting layer 40 and the base body 30, the anti-rewetting layer 40 and the base body 30 may be directly in contact.

[0013]

Figure 3 is a figure to explain anti-rewetting function of a press felt according to the present invention, and is an enlarged partial view of Figure 2.

As shown in Figure 3, a number of openings 44 are provided in

an anti-rewetting layer 40, and this opening 44 is funnel-shaped so that a wet paper web side opening 42a is wider than a press roll side opening 42b.

[0014]

The anti-rewetting layer 40 comprises a thin film which has no openings originally, and is adhered to the felt 10 with staple fibers forming a batt layer, being run through the anti-rewetting layer 40, by needle punching.

By running this batt layer through, the anti-rewetting layer 40 is perforated, and an opening edge section 42 protrudes downward. Thus, an opening 44 of a three dimensional structure, comprising the opening edge section 42, the wet paper web side opening 42a, and the roll side opening 42b, is formed in the anti-rewetting layer 40. In doing so, the opening edge section 42 is provided at an angle, within the felt body 10; therefore, this wet paper web side opening 42a is formed larger than the roll side opening 42b.

[0015]

In addition, a non-oriented film is suitable for the anti-rewetting layer 40. The reason for this will be explained below.

"Non-oriented" in this case does not mean "not being oriented at all", but includes an orientation which is caused due to its own weight in a manufacturing process of a non-oriented film, which is known among those skilled in the art.

[0016]

Furthermore, a low-water-absorbent film such as polyethylene, polypropylene, polyvinylidene, polyester, or a water-absorbent film such as nylon, polyurethane, may be used for a film material.

In addition, as described above, nylon is frequently used for a batt layer 20 or a base body 30 of a press felt for papermaking 10.

In this case, it is best to select a material with a high melting point, such as nylon, polyurethane, polyester, etc. for a film material, so that heat resistance which is necessary for a heating operation in a manufacturing process of a felt may be obtained.

[0017]

As described above, nylon is frequently used at present, as a material for a batt layer 20 and a base body 30. Therefore, it is desirable to use a nylon material for an anti-rewetting layer 40, so that elongation properties of felt components in case where the whole felt is wet are harmonized.

By the way, it was found out from experiments that when an anti-rewetting layer 40 was made of nylon, it was desirable that its thickness was in the range of 20 to 50μm and an elongation at break was 300% or higher.

In addition, this elongation at break changes, depending on a material, and its suitable numerical value for each material is as follows: 300% for polypropylene, 200% for poly vinylidene, 100% for polyester, and 400% for polyurethane.

In addition, it was known that when an elongation at break is smaller than these lower limits, a tear occurs in the direction in which elongation at break was smaller than the lower limits.

[0018]

Next, functions of the embodiment will be explained, referring to Figure 3.

In Figure 3, an arrow shows a moving direction of water.

Firstly, under a nip pressure applied by press rolls, water from a wet paper web transfers to a press felt 10. In doing so, water removed from the felt surface transfers to a roll surface side after passing through an opening 44 of an anti-rewetting layer 40. In this

connection, since the opening 44 is tapered, water is transferred smoothly.

After the felt gets out of the nip pressure, said re-wetting is induced to occur. However, water transferred to the roll side relative to the anti-rewetting layer 40, is intercepted by the anti-rewetting layer 40 and the opening edge section 42, and therefore, it is difficult for water to transfer to the batt layer 20 of the wet paper web side.

In other words, water transfer does not occur where there is no opening 44; in addition, it is difficult for water to transfer through the opening 44 since the roll side opening 42b of the anti-rewetting layer 40 is made narrower than the wet paper web side opening 42a.

[0019]

Here, a suitable manufacturing process for an opening 44 of an anti-rewetting layer 40 will be explained, referring to Figure 4 and Figure 5.

Figure 4 is an enlarged view of a point of a needle 50 used in a manufacturing process, and Figure 5 is a figure showing a manufacturing process of an opening.

[0020]

Firstly, the needle 50, shown in Figure 4, may be used for manufacturing a press felt for papermaking 10 according to the present invention.

In addition, 51 is a point section of the tip of the needle.

[0021]

The body of the needle 50 is usually polygon-shaped in cross section, and a barb 52a for hanging and pushing staple fibers is provided in its edge section 52. In the present invention, it is

necessary that as many staple fibers as possible is pushed into an anti-rewetting layer 40 and a wet paper web side opening 42a is made large. When barbs 52a are provided in two or more of edge sections 52, excellent results may be obtained. Figure 4 shows a needle 50 which is triangle-shaped in cross section, an example in which barbs 52a are provided in all the three edge sections 52.

In addition, a section which is between a point 51 of a needle 50 and a barb 52a closest to the point 51 is referred to as a point length 53.

[0022]

Next, a process of forming an opening 44 in an anti-rewetting layer 40 will be explained in detail, referring to Figures 5 (A)-(E).

Firstly, as shown in Figure 5 (A), a staple fiber is provided on an anti-rewetting layer 40. In addition, a needle 50 is punched into the top of the staple fibers. Then, a point section 51 of the needle 50 passes through the staple fibers and arrives at the anti-rewetting layer 40 (Figure 5 (B)). In doing so, the needle 50 does not immediately perforate the anti-rewetting layer 40, but first pushes down the anti-rewetting layer 40.

[0023]

Furthermore, as the needle 50 moves on, the anti-rewetting layer 40 is torn in a shape of aperture (Figure 5 (C)). This forms a roll side opening 42b.

In addition, among all the torn sections, a section which follows the progress of the point length 53 of the needle 50 and is pushed down, forms an opening tube section 46 which will be explained later.

[0024]

Next, the point length 53 of the needle 50 moves on, the barb

section 52a hooks the staple fibers and pushes them into the lower part of the anti-rewetting layer 40 (Figure 5 (D)). In doing so, when the barb section 52a is provided in a number of edge sections 52, more stable fibers may be pushed into the lower part of the anti-rewetting layer 40.

Along with the transfer of staple fibers, the opening edge section 42 of the anti-rewetting layer 40 is pushed down and formed at an angle.

[0025]

This way, the opening 44 in which the wet paper web side 42a is formed larger than the roll side opening 42b is formed in the anti-rewetting layer 40 (Figure 5 (E)).

After being pushed down to its predetermined position, the needle 50 is once again shifted upward. In addition, after the anti-rewetting layer 40 is shifted by the predetermined distance in the horizontal direction, the needle 50 once again moves downward to punch the staple fibers into the top of the anti-rewetting layer 40, and this action is repeated.

[0026]

This way, the opening 44 of the anti-rewetting layer 40 is formed. When a non-oriented film is used for this anti-rewetting layer 40, it may be prevented beforehand that the anti-rewetting layer 40, around the wet paper web side opening 42a and the opening edge section 42, will be torn significantly due to the shock at the time of perforation, and the openings 44 will be connected, thus, and a film is fractured.

In addition, when a non-oriented film is used, no tear occurs in the opening even when the density of the needle punching is high, since the film itself has elasticity, absorbing the shock at the time of

needle punching; therefore, the density of needle punching may be increased, and an improvement of adhesion of a batt may be achieved.

[0027]

Furthermore, it is found out that when a non-oriented film is used for the anti-rewetting layer, an excellent anti-rewetting structure may be achieved in view of the following two points:

(1) Distance between a wet paper web side opening and a roll side opening is long, since a film stretches along with a needle pushing batt fibers; and

(2) The diameter of the roll side opening shrinks at the time of needle punching when a needle, which moves to the lowest position is shifted upward and gets out of the roll side opening. As a result, the diameter of the roll side opening becomes small.

[0028]

On the other hand, when a uniaxially oriented film or a biaxially oriented film is used for an anti-rewetting layer, there is a problem, that an opening tears and a film gets torn easily. When compared with a uniaxially oriented film, an opening of a biaxially oriented film in particular does not get torn easily, but once the conditions of needle punching becomes severe, the opening tends to tear.

More specifically, it was found out from the experiment that when density of needle punching exceeds 100 times/cm^2, an opening tears in the direction of a higher stretch ratio of a biaxially oriented film.

[0029]

In addition, the needling operation, which is described above, is conducted by driving up and down a needle board (not shown), on which many needles 50 are provided. In this connection, the opening 44 may be formed by punching staple fibers into said anti-rewetting layer 40, using a needle 50 of a single kind and a single thickness.

On the other hand, it is possible to provide needles of various kinds on a single needle board so that demanded functions of a felt for papermaking, such as the permeability, etc. may be achieved.

[0030]

For example, when there is a purpose of obtaining permeability, it is possible to provide a needle 50, which is thicker than other needles 50, the point of which is sharp, wherein a barb section 52a is provided in only one edge section 52 as well as a needle 50 having barb sections 52a in all the edge sections 52 which is described above on a single needle board.

In this case, an opening 44 of a three-dimensional structure, in which a wet paper web side opening 42a is formed larger than a roll side opening 42b, and an opening (not shown), which is plane and larger than the opening 44 are formed at the top of an anti-rewetting layer 40.

Thus, a felt which may prevent re-wetting to some extent and are excellent in permeability may be provided.

[0031]

Next, an example will be explained, in which a structure of an opening 44 is changed by a difference of elongation at break of a non-oriented film.

An anti-rewetting layer 40, in which an opening 44 is formed, is shown in Figure 6. In addition, as for a needle for forming the opening 44 of Figure 6, barb sections 52a are formed in all the edge sections 52.

An opening 44, in a case where a non-oriented film of a large elongation at break is used, is shown in Figure 6 (A). As described above, an opening tube section 46 is formed at the opening edge section 42 by using a needle 50. Since the whole opening 44 is formed in a funnel shape due to this opening tube section 46, water may

be effectively prevented from moving through a roll side opening 42b.

[0032]

In addition, an opening 44, in a case where a non-oriented film of small elongation at break is used, has a formation which is shown in Figure 6 (B).

In other words, while a sloped opening edge section 42 may be formed in an anti-rewetting layer 40, by staple fibers drawn by a barb section 52, few opening tube section 46 may be formed. This structure is inferior to that of the opening 44, having an opening tube section 46, in view of an anti-rewetting effect, but when it is necessary to improve productivity, etc. it may be chosen appropriately.

[0033]

A manufacturing process of the whole felt will be described later, but, when needle punching is conducted after an anti-rewetting layer 40 is provided on a layer of staple fibers and a layer of staple fibers is provided on this anti-rewetting layer 40, an opening edge section 42 tends to protrude downward at an angle since it is formed under the condition of being supported by the layer of staple fibers which is under the anti-rewetting layer 40. Furthermore, the number of tears in the anti-rewetting layer 40 decreases since the shock from needle punching is eased by this lower layer of staple fibers. In other words, when needle punching is conducted in the condition in which a layer of staple fibers is provided at the bottom of an anti-rewetting layer 40, it is possible to produce an opening 44 wherein a wet paper web side opening 42a is larger than a roll side opening 42b.

[0034]

Next, a manufacturing process of the whole press felt 10 according to the present invention will be explained. It will be evident that various modifications and changes may be made to this

manufacturing process and the following process is only an illustration.

[0035]

Firstly, after a layer of staple fibers is provided on a base body 30 and both of them are intertwiningly integrated by needle punching, the front and the back of the base body 30 are reversed.

The base body 30 and a batt layer 20 on the roll side are formed in this situation.

[0036]

Next, a surface of a wet paper web side is to be formed. There are roughly two patterns in this process, and either pattern may be adopted.

(1) A process comprising: piling an anti-rewetting layer 40 and a layer of staple fiber on a base body 30 sequentially; and intertwiningly integrating them with the base body 30 by needle punching.

(2) Another process comprising: firstly, providing a layer of staple fiber on an anti-rewetting layer 40; integrating them by needle punching, and thus, forming a preliminary layer 60; then, providing this preliminary layer 60 on a base body 30; and intertwiningly integrating them by needle punching.

In addition, in the case of producing a press felt for papermaking having a batt layer 20 between an anti-rewetting layer and a base body 30, it may be produced by providing a layer of staple fiber on a base body 30 and thereafter, providing an anti-rewetting layer 40 or a preliminary layer 60 on the layer of staple fiber.

[0037]

Next, methods of providing an anti-rewetting layer 40 or a preliminary layer 60 on a base fabric 40 will be explained referring to Figure 7 - Figure 9. In addition, in the figures, 70 represents a material roll on which an anti-rewetting layer 40 or a preliminary layer

60 is wound, and 80 represents stretch rolls between which a base body 30 is spanned.

[0038]

Firstly, Figure 7 shows a manufacturing method including a step of providing an anti-rewetting layer 40 or a preliminary layer 60 of almost the same width in a cross machine direction as a base body.

In this case, firstly, an end of an anti-rewetting layer etc. 40, 60 is fixed on a base body 30. Then, along with the rotation of the base body 30, the anti-rewetting layer, etc. 40, 60 are drawn from a material roll 70, and the anti-rewetting layer, etc. 40, 60 are provided on the base body 30.

After the anti-rewetting layer 40, 60 are all provided on the base body 30, the anti-rewetting layer, etc. 40, 60 are cut almost in the same position as the end fixed on said base body 30, and this cut end is fixed on the base body 30.

[0039]

Next, Figure 8 and Figure 9 show manufacturing methods using an anti-rewetting layer 40 of width in a cross machine direction shorter than that of a base body 30.

In this case, as shown in Figure 8, it is possible to wind the anti-rewetting layer, etc. 40, 60 in spiral, almost along a machine direction of the base body 30.

[0040]

On the other hand, as shown in Figure 9, it is also possible to provide the anti-rewetting layer, etc. 40, 60, almost along a cross machine direction of the base body 30. In this case, it is desirable to provide only the anti-rewetting layer 40 instead of using the preliminary layer 60. More specifically, the anti-rewetting layer 40 is provided on the base body 30 from the one end of to the other, in an

appropriate angle to a cross machine direction. Afterwards, the anti-rewetting layer 40 is turned down and placed on the base body 30 in the direction to the one end; then, this action is repeated. In this case, the anti-rewetting layer 40 is fixedly provided on the base body 30, particularly by the weight of its turned part at the end of the base body 30. Furthermore, it is needless to say that the angle of the anti-rewetting layer 40 needs to be adjusted so that the anti-rewetting layer 40 covers the entire base body 30.

[0041]

In addition, as described above, a film with no openings is used for the anti-rewetting layer 40. However, it is also possible to adopt a structure, which may improve permeability in accordance with the necessity for a needle felt for papermaking.

In this case, it is possible to adopt a manufacturing method including a step of needling and perforating only the anti-rewetting layer 40 appropriately.

[0042]

[Examples]

The following experiments were conducted to determine effects of a press felt for papermaking according to the present invention.

In addition, in order to provide equal conditions for examples and comparative examples, the basic structure of all felts was as follows:

Base body (plain weave of twisted yarn of nylon mono-filament): Basis weight of 300g/m^2

Batt layer (staple fiber of nylon 6): Total basis weight of 550g/m^2

Needle punching density: 1000 times /cm^2

Used needle: Needle having a point section 51 (R: 0.075mm) at

its tip, of which a cross section was the shape of triangle, and of which a barb section 52a was formed in every edge section 52.

[0043]

(Example 1)

Anti-rewetting layer 40: Non-oriented film made of nylon

Elongation at break: 500%

Thickness: 25 μ

Shape of opening 44: Funnel-shaped

Permeability: 5cc/cm^2/sec

[0044]

(Example 2)

Anti-rewetting layer 40: Non-oriented film made of nylon

Elongation at break: 300%

Thickness: 25 μ

Shape of opening 44: Funnel-shaped

Permeability: 6cc/cm^2/ sec

[0045]

(Comparative Example 1)

Anti-rewetting layer 40: Biaxially oriented film made of nylon

Elongation at break: 125%

Thickness: 25 μ

Shape of opening 44: Funnel-shaped, but a tear in the direction of an orientation of a film was found. The tear was not so large as to connect two openings, 44, 44.

Permeability: 10cc/cm^2/ sec

[0046]

(Comparative Example 2)

Anti-rewetting layer 40: Uniaxially oriented film made of

nylon

Elongation at break: 45%

Thickness: 25 μ

Shape of opening 44: Funnel-shaped, but a tear in the direction of orientation of a film was large. Two openings 44, 44, are connected because of the tear.

Permeability: 15cc/cm^2/ sec

[0047]

After these press felts for papermaking were prepared, experiments were conducted, using apparatuses shown in Figure 10 and Figure 11.

Firstly, as for the apparatuses shown in Figure 10 and Figure 11, P represents a press roll, 110 represents a top side felt, 10 represents a bottom side felt, SC represents a suction tube, and SN represents a shower nozzle in the figures.

In addition, said examples and said comparative examples are used as the bottom side felt 10 for the both apparatuses. In this case, the same press felt as Comparative Example 1 was used for the top side felt.

In addition, the apparatuses shown in Figure 10 and Figure 11 both have the felt's travel speed of 500m/min, and the press pressure of 100kg/cm^2.

[0048]

The apparatus shown in Figure 10 has a structure, in which the wet paper web that gets out of the nip pressure is placed on the bottom side felt 10 and transferred.

Therefore, water content of a wet paper web, in which re-wetting occurs, may be obtained, by measuring water content of the wet paper web at a position (press exit I), to which it is transferred

after it gets out of the nip pressure and is put on the bottom side felt 10.

[0049]

On the other hand, the apparatus shown in Figure 11 has a large area in which the bottom side felt 10 comes in contact with the press roll, and the time in which the wet paper web getting out of the nip pressure is in contact with the felts 10, 110 is very short. Here, water content of the wet paper web, in which re-wetting does not occur greatly, may be obtained, by measuring water content of the wet paper web at the position in which it is placed right after it gets out of the nip pressure (press exit II).

[0050]

Here, an evaluation of re-wetting was conducted, by obtaining a difference between the water content, measured by the apparatus in Figure 10 and the one measured by the apparatus in Figure 11. In this connection, it was assumed in the evaluation that re-wetting did not occur when the difference between the two was 0.5% or less, and re-wetting occurred when it was 0.5% or more.

[0051]

The summary of the results is shown in Figure 12.

As shown in Figure 12, it was known that a press felt for papermaking according to the present invention may suppress re-wetting effectively and exhibit excellent effects.

[0052]

[Advantages of the Invention]

As described above, the present invention may provide a press felt for papermaking with a relatively simple structure, having an excellent anti-rewetting effect.

[Brief Description of the Drawings]

[Figure 1] An exploded perspective view of a press felt according to the present invention;

[Figure 2] A cross-sectional view of a press felt according to the present invention;

[Figure 3] An enlarged cross-sectional view of a main part of a press felt according to the present invention;

[Figure 4] An enlarged view of a point of a needle used in the production of a press felt according to the present invention;

[Figure 5] (A)-(E) are enlarged explanatory views, showing a formation process of an opening of an anti-rewetting layer of a press felt according to the present invention;

[Figure 6] (A), (B) are enlarged cross-sectional views, showing different embodiments of an opening of an anti-rewetting layer of a press felt according to the present invention;

[Figure 7] A perspective view, showing a manufacturing process of a press felt according to the present invention;

[Figure 8] A perspective view, showing another manufacturing process of a press felt according to the present invention;

[Figure 9] A perspective view, showing yet another manufacturing process of a press felt according to the present invention;

[Figure 10] An explanatory view of an apparatus for determining effects of a press felt according to the present invention;

[Figure 11] An explanatory view of another apparatus for determining effects of a press felt according to the present invention;

[Figure 12] A figure showing results of experiments;

[Figure 13] A schematic view of a press apparatus of a papermaking machine;

[Figure 14] An explanatory view of a transfer condition of water in a wet paper web; and

[Figure 15] A cross-sectional view of a conventional press felt.

[Explanation of Reference Letters or Numerals]

10: Press felt for papermaking

30: Base body

20: Batt layer

40: Anti-rewetting layer

44, 44: Opening

42: Opening edge section

42a: Wet paper web side opening

42b: Roll side opening

46: Opening tube section

[Document Name] Abstract

[Problem]

To provide a press felt for papermaking, which has an excellent anti-rewetting effect while maintaining water removing capability.

[Solution Means]

A press felt 10 comprises a base body 30, a batt layer 20, and an anti-rewetting layer 40 comprising a non-oriented film, all intertwiningly integrated by needle punching.

The anti-rewetting layer 40 has an opening 44 of a three-dimensional structure, comprising an opening edge section 42, a wet paper web side opening 42a and a roll side opening 42b. Here, the wet paper web side opening 42a is formed larger than the roll side opening 42b.

Under nip pressure, water from a wet paper web W transfers to the roll surface side after passing through an opening 44 of the anti-rewetting layer 40.

When the press felt 10 gets out of the nip pressure, re-wetting is induced to occur. However, it is difficult for water to pass through the opening 44 since the roll side opening 42b is formed narrower than the wet paper web side opening 42a.

[Selected Drawing] Figure 3

FIG. 1

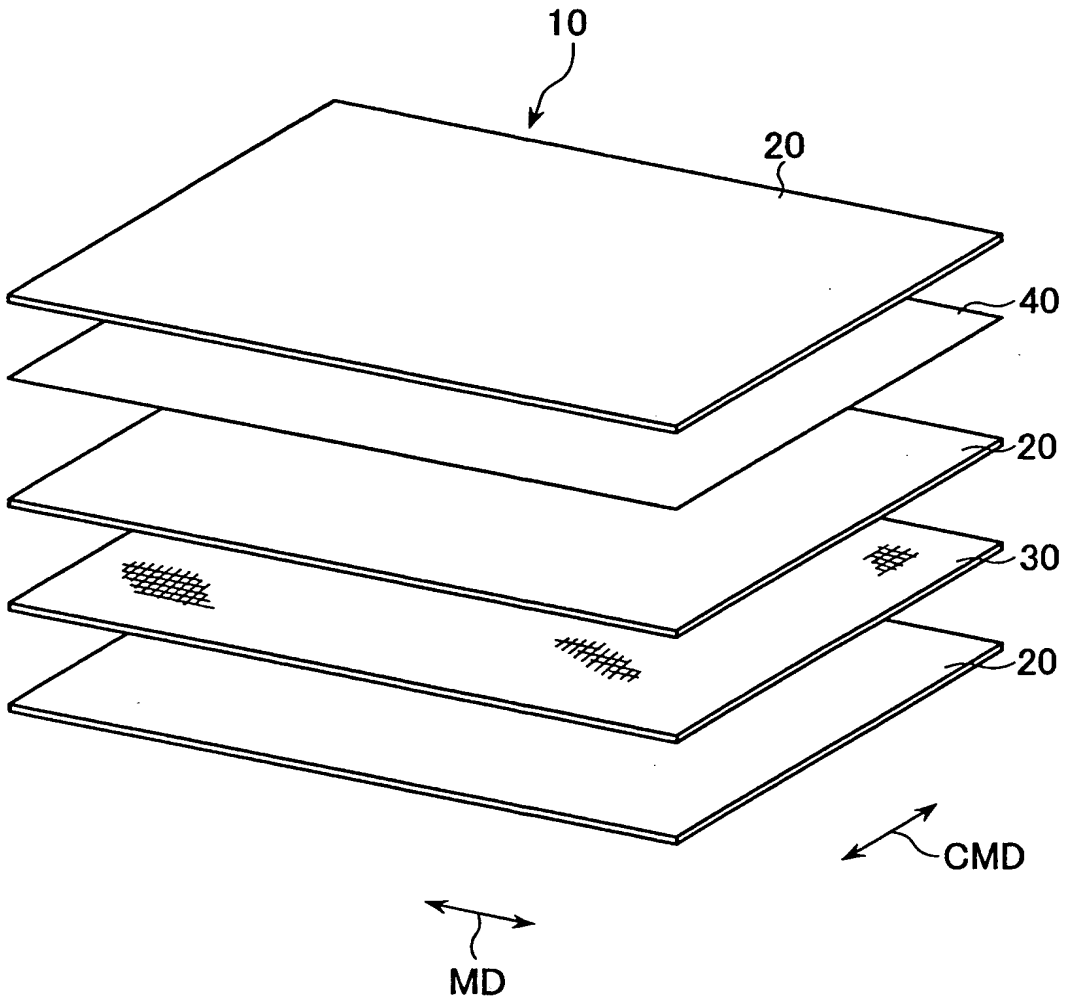


FIG. 2

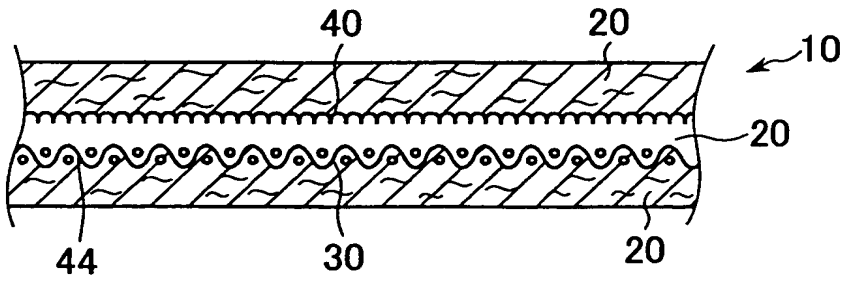


FIG.4

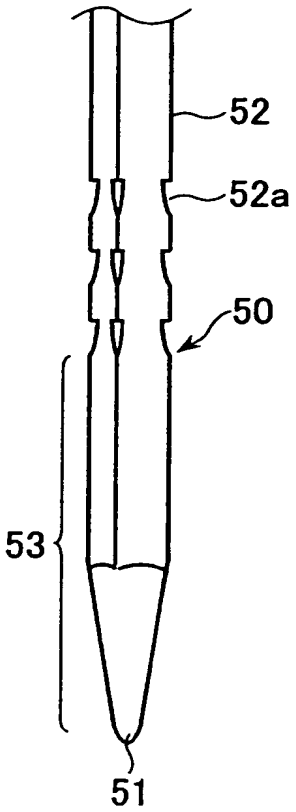


FIG. 3

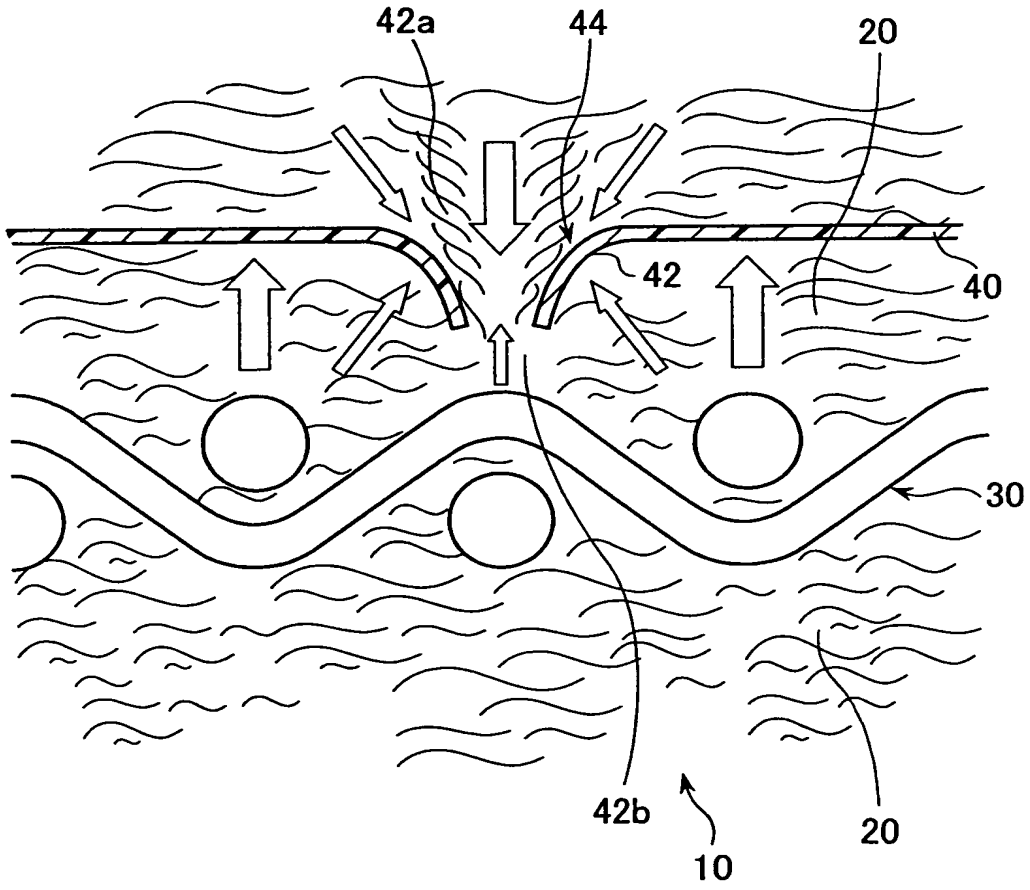


FIG. 5(A)

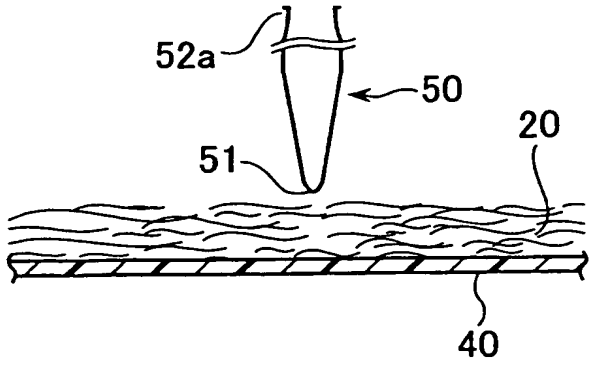


FIG. 5(B)

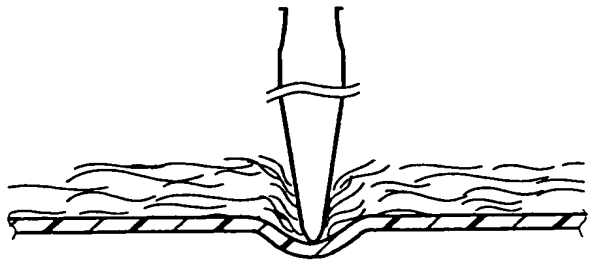


FIG. 5(C)

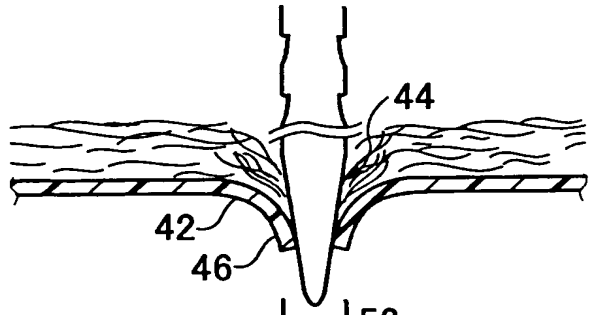


FIG. 5(D)

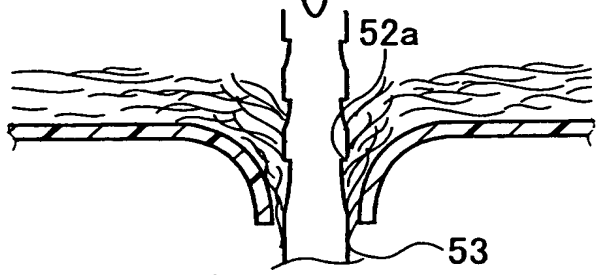


FIG. 5(E)

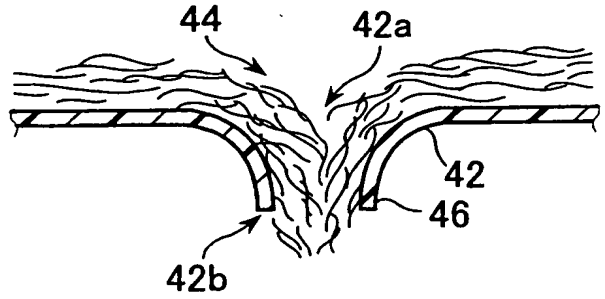


FIG. 6(A)

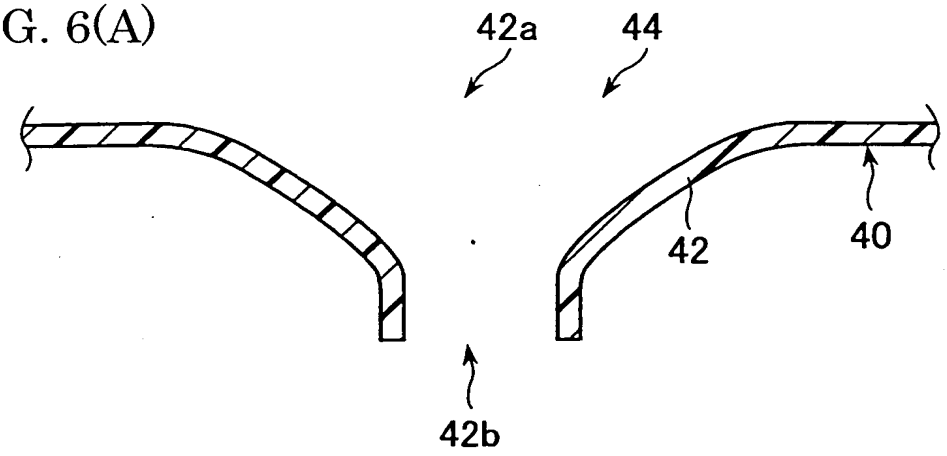


FIG. 6(B)

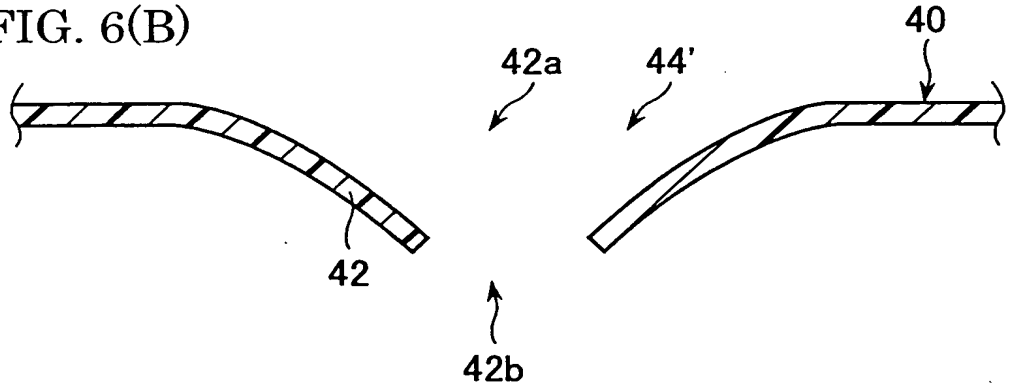


FIG.7

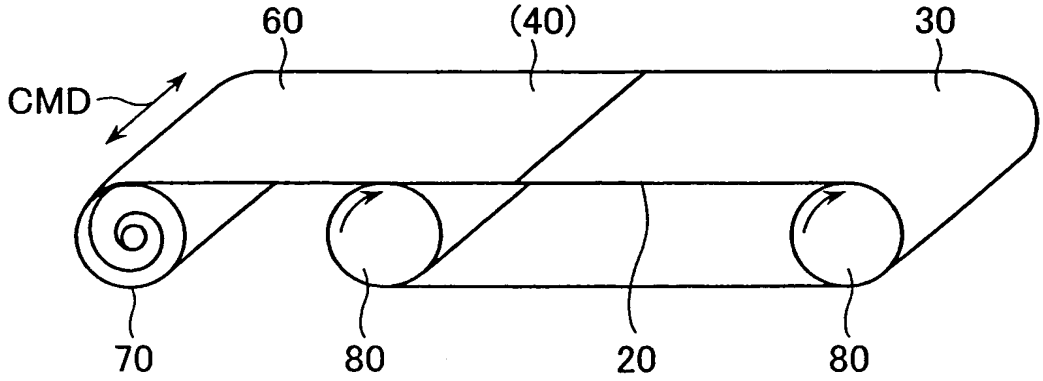


FIG.8

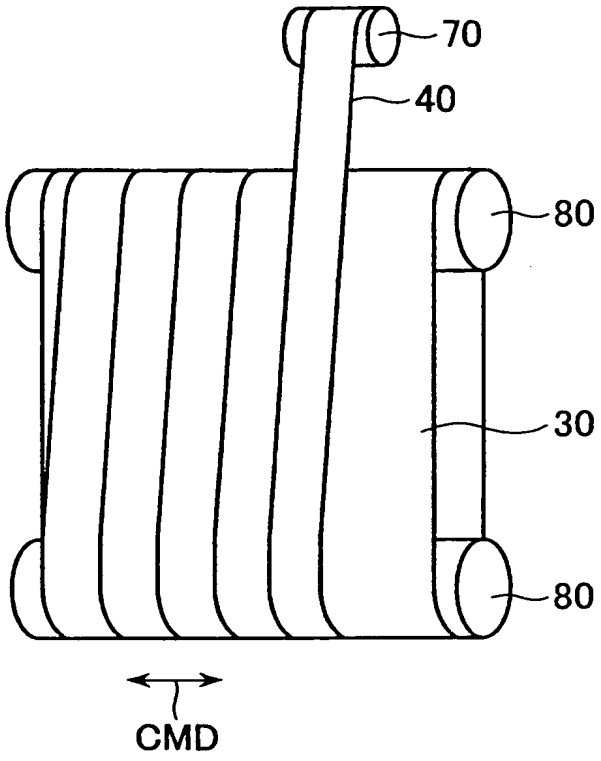


FIG. 9

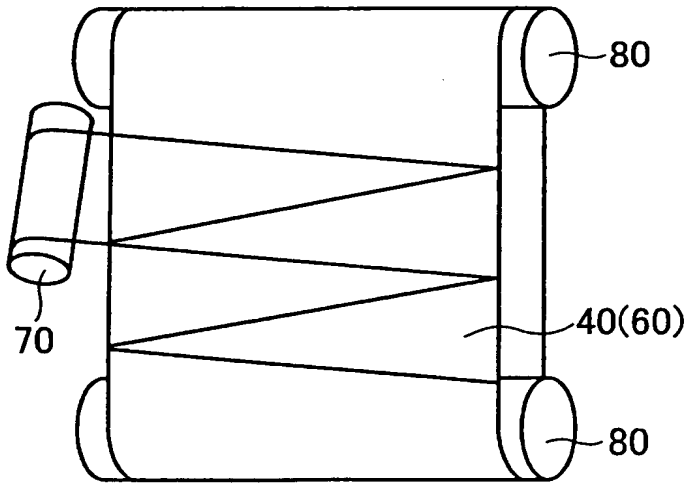


FIG. 10

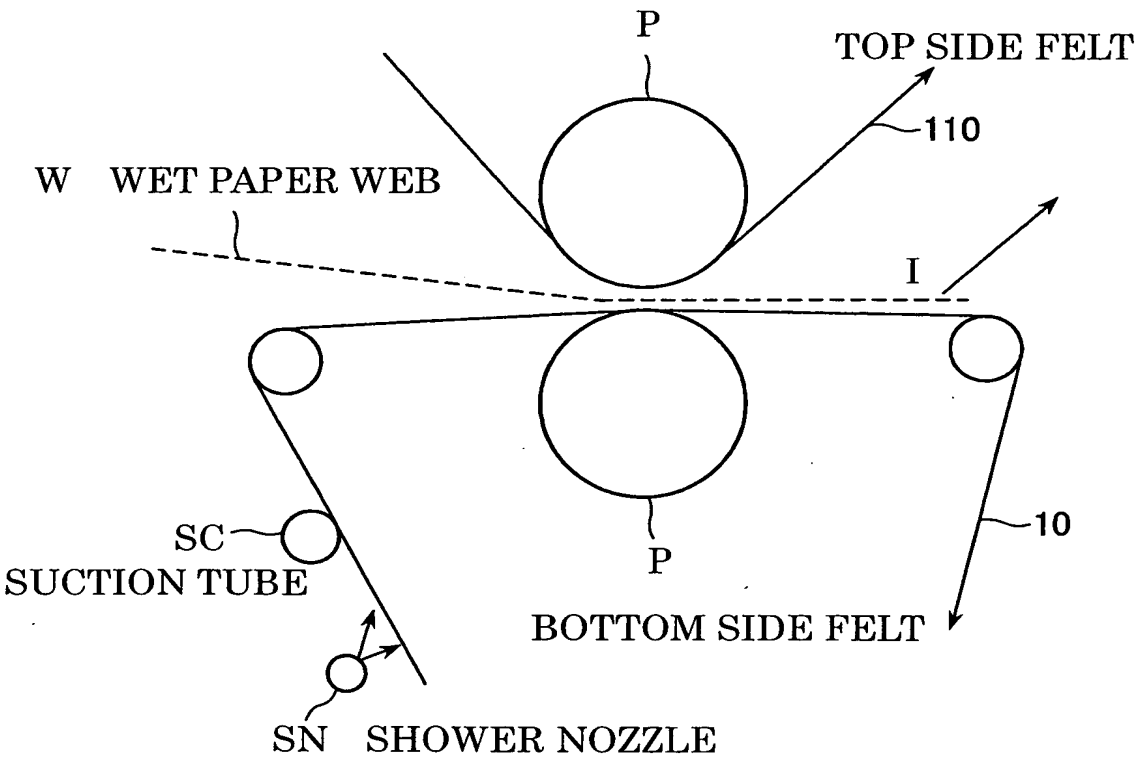
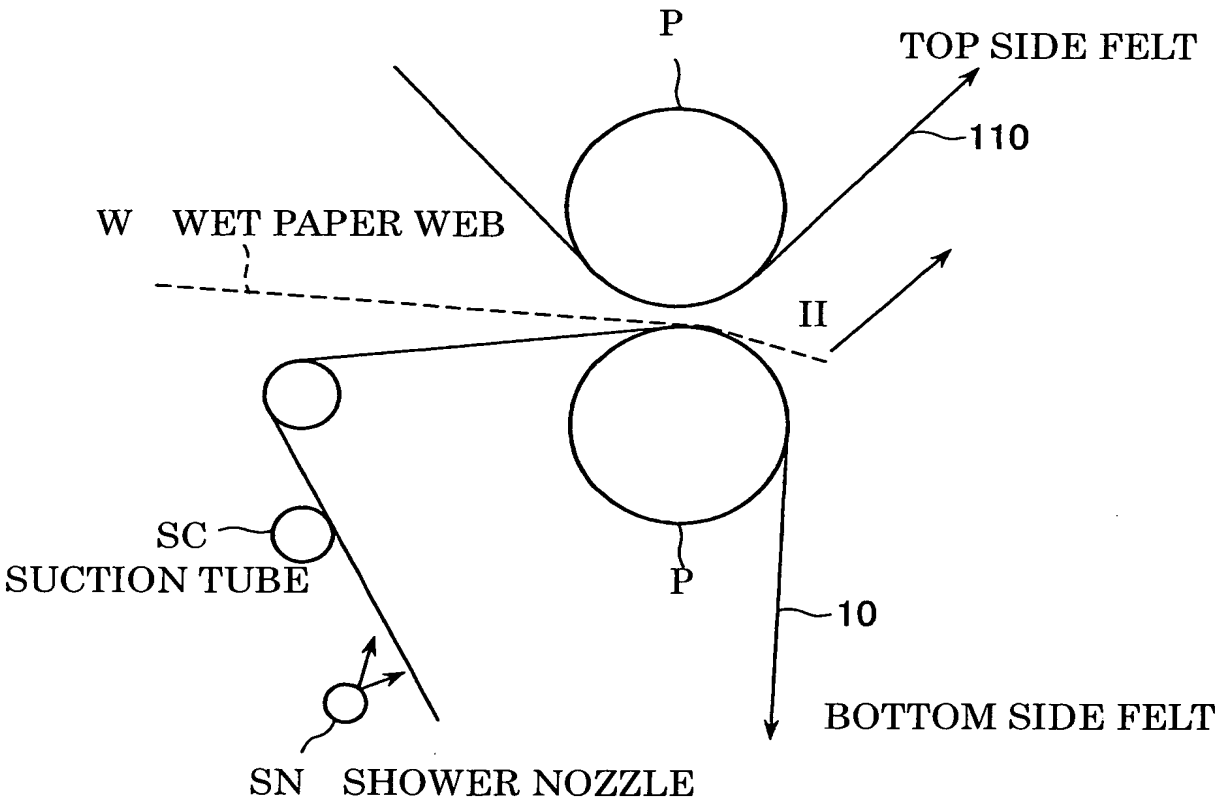

RE－WETTING TEST
P
TOP SIDE FELT
110
W WET PAPER WEB
I
SC
SUCTION TUBE
P
10
BOTTOM SIDE FELT
SN SHOWER NOZZLE
SAMPLING
WATER CONTENT AT PRESS EXIT 1

FIG. 11

RE－WETTING TEST



SAMPLING
WATER CONTENT AT PRESS EXIT II

FIG.12

	anti-rewetting layer	physical properties of film	needle punching density	permeability	perforation condition	water content at press exit I (%)	water content at press exit II (%)	value of I − II (%)	evaluation of re-wetting
Example 1	nylon-made non-oriented film	elongation at break: 500% thickness: 25 μ	1000 times/cm^2	5 $cc/cm^2/sec$	funnel-shaped, no tear	48.3	48.0	0.3	excellent
Example 2	nylon-made non-oriented film	elongation at break: 300% thickness: 25 μ	ditto	6 $cc/cm^2/sec$	funnel-shaped, no tear	48.2	48.0	0.2	excellent
Comp. Example 1	nylon-made biaxially oriented film	elongation at break: 125% thickness: 25 μ	ditto	10 $cc/cm^2/sec$	funnel-shaped, small tear	48.7	47.7	1.0	poor
Comp. Example 2	nylon-made uniaxially oriented film	elongation at break: 45% thickness: 25 μ	ditto	15 $cc/cm^2/sec$	funnel-shaped, openings are connected because of tear	50.0	48.0	2.0	poor

FIG. 13

PRIOR ART

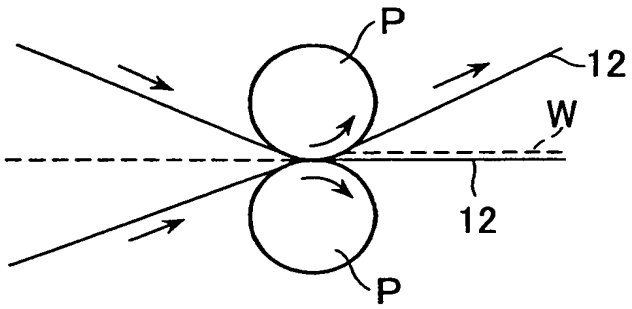


FIG. 14

PRIOR ART

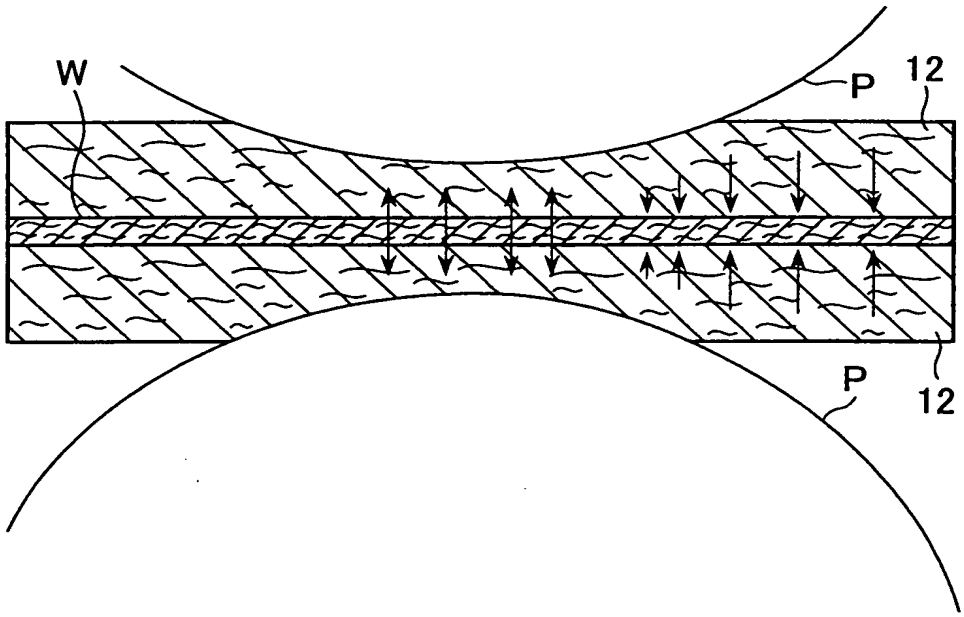


FIG. 15

PRIOR ART